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Depressive Symptomatology and Physical Exercise Despite Physical Harm or Injury in University Students

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Abstract

The aim of the present study was to examine the relationship between depressive symptomatology and persistence in physical exercise in the presence of physical harm or injury. Data obtained from 345 university students (52.50% female) aged 18-37 years (M_{age} = 21.67; SD_{age} = 3.48) who reported engaging in recreational exercise at least once a week were analysed. The data were analysed using regression analyses using a robust maximum likelihood (RML) estimation method. These analyses accounted for the effects of age, gender, body mass index, perceived health status, frequency of physical exercise, and level of risk of eating disorders. In the first regression analysis, depressive symptomatology (β = .193, 95% CI = .098 to .288, p < .001) explained a significant proportion of variance in exercising in the presence of physical harm or injury (18.30%). In the second regression analysis, exercising in the presence of physical harm or injury (β = .186, 95% CI = .111 to .261, p < .001) explained a significant proportion of variance in depressive symptomatology (18.80%). The present findings suggest the need to further examine the variables that could condition the relationship between depressive symptomatology and exercising in the presence of physical harm or injury, as well as the possible causal nature of this relationship.

Keywords: depressive disorders, eating disorders, exercise addiction, exercise dependence, morbid exercise.

Introduction

The term *problematic exercise* has been introduced to refer to all forms of physical exercise that are not necessarily healthy (Sicilia et al., 2022). This term refers to a complex phenomenon that, in any of its multiple manifestations, can compromise some of the benefits derived from exercise (Alcaraz-Ibáñez et al., 2022b). One of the most frequently investigated possible manifestations of problematic exercise is that defined according to the six criteria proposed for behavioural addictions. These include *salience* (i.e., exercise becomes the central activity in the person's life, to the extent that it dominates their thoughts, feelings and behaviour), *conflict* (i.e., the occurrence of conflict between the person and those around them, with other social/professional activities, or with themselves arising from exercise habits), *mood modification* (i.e., use of exercise as a way of experiencing positive feelings, to the extent that the activity becomes a form of coping), *tolerance* (i.e., the need for higher volumes of exercise to obtain the desired effects that were obtained in the past with lower volumes of exercise), *withdrawal* (i.e., experiencing negative mood states such as irritability or sadness and/or negative physical effects such as pain or muscle tension when exercise is stopped or drastically reduced) and *relapse* (i.e., the tendency to repeat excessive past exercise patterns after periods of self-control) (Terry et al., 2004).

One issue that has been a matter of great controversy in the context of the study of behavioural addictions, and particularly with regard to exercise addiction, is whether to consider this phenomenon as a psychopathological process in its own right or, alternatively, as a co-morbidity of other mental disorders (Starcevic & Khazaal, 2017). Irrespective of this debate, the results of several review studies suggest that depressive processes are one of the mental health problems most closely related to various behavioural addictions (Elhai et al., 2017; Starcevic & Khazaal, 2017). This relationship has been based on a twofold possibility. First, that engaging in a pleasurable behaviour (e.g., exercise) as a way of coping with the discomfort inherent in depressive processes could lead to the emergence of addictive patterns in the performance of the behaviour. Secondly, that some of the processes underlying the addictive patterns of behaviour (e.g., the existence of conflicts or the presence of withdrawal symptoms) could impair the person's mood to the point of increasing the presence of depressive symptomatology (Gámez-Guadix, 2014).

The results of a recent study comprising a study population of regular exercisers (defined as those who engaged in physical activity at least once a week; Lichtenstein et al, 2018) revealed a positive relationship between self-reported levels of exercise addiction and depressive symptomatology, which was independent of gender, age, body mass index (BMI), or risk status in terms of risk of eating disorder (ED) (Alcaraz-Ibáñez et al., 2022a). In this regard, evidence suggesting that the instrument used in this study (i. e., Exercise Addiction Inventory, EAI; Terry et al., 2004) might reflect an over-involvement in activity that is not necessarily pathological (Szabo et al., 2015), led the authors to consider two other possible confounding variables: (i) frequency of exercise and (ii) perceived level of health. Confirming the non-problematic nature of the presence of high EAI scores, these were positively related to both exercise frequency and perceived levels of health (Alcaraz-Ibáñez et al., 2022a).

An alternative approach to using EAI to characterise problematic exercise patterns is to consider some context-specific exercise behaviours that, although not part of the generic criteria proposed for behavioural addictions (Szabo et al., 2015), unambiguously imply harm. An example of this would be persisting with exercise despite suffering some kind of physical harm or injury (Lichtenstein & Jensen, 2016; Pálfi et al., 2021). However, the relationship between this behaviour and depressive symptomatology has not been investigated to date.

The present study was designed to replicate the findings of a recent study that examined the relationship between depressive symptomatology and exercise addiction (Alcaraz-Ibáñez et al., 2022a), considering exercise performed in the presence of physical harm or injury instead of the latter variable. In line with the hypotheses tested in the above-mentioned baseline study, it was expected that, after accounting for the effects of several potential confounding variables (i.e., risk of ED, frequency of exercise, perceived health status, gender and BMI), there would be a positive relationship between depressive symptomatology and exercise in the presence of physical harm or injury. Given

the potential bidirectional nature of the relationship under examination (Gámez-Guadix, 2014), the relationship between the two variables of interest was expected to exist irrespective of whether they were configured as dependent or independent in the statistical analyses.

Methodology

Participants

A total of 385 students enrolled in a public university in southern Spain were invited to participate in the study. In line with the study proposal whose results are to be replicated (Alcaraz-Ibáñez et al., 2022a), participants were considered eligible if they reported engaging in recreational exercise (i.e. exercise for which no financial compensation is received) at least once a week at the time of the study (Lichtenstein et al., 2018). The adoption of this inclusion criterion meant that 40 of the potential participants in the sample whose data were analysed were excluded. Participants mainly performed exercise modalities aimed at improving endurance (e.g., running or cycling, 30%), team sports or individual sports not specifically aimed at improving endurance (26%), exercise modalities aimed at improving general health and fitness (e.g., those carried out in fitness centre settings, 22%), strength-oriented exercise modalities (e.g., weight training or crossfit, 12%), and multiple modalities (10%) Thus, the sample ultimately analysed comprised a total of 345 participants (52.50% female), whose ages and BMIs ranged respectively between 18 and 37 years (M_{age} = 21.67; SD_{age} = 3.48) and 16.59 and 34.63kg/m^2 (M_{BMI} = 23.03; SD_{BMI} = 3.02). Participants identified themselves as Caucasian (96%), North African (3%) and Latino (1%).

Materials and Resources

Practice of physical exercise in the presence of physical harm or injury. Assessed using a Spanish adaptation of the English item previously proposed for this purpose (*i. e., I exercise in spite of pain and injuries*) (Lichtenstein & Jensen, 2016) (Responses were provided using a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*).

Depressive symptomatology. Assessed using the depression subscale of the Spanish version of the Brief Symptom Inventory-18 (BSI-18; Derogatis, 2000). Scored on a 5-point Likert scale ranging from 0 (*not at all*) to 4 (*extremely*), the 6 items included in the instrument assess distress generated by the presence of depressive symptoms (i.e., apathy, sadness, self-loathing, anguish, hopelessness and suicidal ideation) experienced during the past 7 days. Composite reliability and internal consistency indices of ρ = .93 and α = .89, respectively, were obtained in the present study.

Risk of eating disorder (ED). Assessed using the Spanish version (Garcia-Campayo et al., 2005) of the SCOFF questionnaire (Morgan et al., 1999). Answered dichotomously (i.e., yes or no), the five items included in this instrument reflect key features of anorexia and bulimia nervosa (e.g., the presence of intrusive thoughts about food). Two or more positive responses indicate the presence of risk of ED (Morgan et al., 1999). Sensitivity values of 80% and specificity values of 93% have been reported in this context for SCOFF (Botella et al., 2013).

Frequency of exercise. Assessed using the following two items (Prochaska et al., 2001): (i) "During the last 7 days, on how many of those days have you exercised for at least 30 minutes?" and (ii) "In a typical week, on how many days do you usually exercise for at least 30 minutes?". In a similar manner to that proposed by previous work in the context of the study of potentially problematic patterns of physical exercise, the composite score of both items was considered (Alcaraz-Ibáñez et al., 2019). Composite reliability and internal consistency indices of ρ = .94 and α = .92, respectively, were obtained in the present study.

Perceived health status. Assessed using the Spanish version (Alonso et al., 1995) of the SF-1 derived from the short version of the Health Status Questionnaire (Ware Jr. & Sherbourne, 1992). Scored on a 5-point Likert scale ranging from 0 (*excellent*) to 5 (*poor*), this single item ("Overall, would you say your health status is...") provides a simple index of perceived general health status. Once the scores are reversed, higher scores imply higher levels of perceived health.

Sociodemographic variables. Participants provided their gender, age, ethnicity, main mode of physical exercise, height and weight, the latter two variables being used to calculate BMI (kg/m^2).

Procedure

Firstly, approval was obtained from the ethics committee of the University of Almeria (UALBIO2017/009). At the beginning of a teaching session, potential participants were then invited to collaborate in a study aimed at finding out about exercise habits and the students' perception of health. After being informed of the voluntary, anonymous, non-monetary and non-academically compensated nature of their participation, those potential participants who gave their consent completed a questionnaire in paper format. This task took no more than six minutes. The study was conducted in accordance with the ethical principles for biomedical research involving human subjects, as set out in the World Medical Association Declaration of Helsinki (as amended in 2013).

Statistical Analysis

A similar analytical approach to the one used in the study whose results were to be replicated (Alcaraz-Ibáñez et al., 2022a) was adopted, considering in this case the practice of physical exercise in the presence of physical problems or in situations of injury instead of the symptoms of behavioural addictions adapted to the context of exercise. First, descriptive statistics and correlations (r) between the study variables were obtained. Differences (d) were then calculated by gender and level of ED risk for the different study variables, which were interpreted as trivial (.00 to .20), small (.20 to .50), moderate (.50 to .80), or large (> .80) (Cohen, 1988).

The measurement model for the two specified latent variables (i.e., depressive symptoms and frequency of physical exercise) was then examined using Confirmatory Factor Analysis (CFA) techniques using Mplus 7 software(Muthén & Muthén, 1998-2015). Given the ordered categorical nature of the variables of interest, this analysis was carried out using the Weighted Least Squares Mean and Variance-adjusted (WLSMV) robust estimation method (Li, 2015). Missing values (< 1%) were accounted for using the imputation methods implemented for this purpose in the Mplus 7 software. Values in the Comparative Fit Index (CFI) above .96, in the Root Mean Square Error of Approximation (RMSEA) below .08 and in the Weighted Root Mean Residual (WRMR) below 1.00 were considered indicative of an excellent fit of the data to the model (Yu, 2002). Latent factor scores for depressive symptoms and frequency of physical exercise were derived from the CFA results described above using the FSCORES function implemented in the Mplus 7 software (Muthén & Muthén, 1998-2015). These latent scores were used to examine the multivariate relationships of interest. This way of proceeding enabled measurement errors to be considered without needing to set up all possible latent variables as such in the regression models tested, thereby allowing for a ratio between cases and estimated parameters higher than the minimum recommended (Kline, 2011). Thus, depressive symptoms and exercise in the presence of physical harm or injury were respectively considered as dependent variables in two regression models specified in Mplus 7 in which age, gender, BMI, perceived health status and level of risk for ED were included as independent variables. Depending on the presence of both dichotomous variables (e.g., gender or level of risk of ED) and continuous variables (e.g., latent factor scores) and also taking into account the nested nature of the data (given that the data were obtained from different groups of students), the regression analyses described above were performed using the Maximum Likelihood Robust (MLR) method and the COMPLEX function implemented in the Mplus 7 software (Muthén & Muthén, 1998-2015).

Results

Descriptive statistics, correlations between the study variables, and differences in the variables according to gender and level of risk of ED are shown in Table 1. 22% of the participants were at risk of developing an ED according to the results of the screening instrument used (Morgan et al., 1999). Physical exercise in the presence of physical harm or injury correlated (i) negatively with age (r = -.14, p = .01) and (ii) positively with perceived health status (r = .10, p = .05), frequency of exercise (r = .23, p < .001) and depressive symptomatology (r = 14, p = .01). In turn, depressive symptomatology was negatively correlated with perceived health status (r = -.18, p = .01). Differences of moderate significance were observed that favoured (i) men in levels of exercise practice in the presence of physical harm or injury (d = 0.47) and (ii) women in levels of depressive symptomatology (d = 0.47). These differences favoured participants classified as being at risk of developing an ED over those who were not for (i) depressive symptomatology (d = 0.76) and (ii) levels of exercise in the presence of physical harm or injury (d = 0.18), the significance of the differences being moderate and trivial, respectively.

Table 1
Descriptive statistics, analysis of differences and correlations between the study variables.

	Gender					ED Risk					Complete sample (*N* = 345)							
	Female (*n* = 181)		Male (*n* = 164)			No (*n* = 268)		Yes (*n* = 77)										
	M	*SD*	*M*	*SD*	*d*	*M*	*SD*	*M*	*SD*	*d*	Range	*M*	*SD*	1	2	3	4	5
1. Age	21.75	2.94	21.58	4.00	-0.05	21.73	3.38	21.47	3.82	-0.08	18-37	21.52	3.16	-				
2. BMI	22.45	3.30	23.67	2.52	0.41	22.51	2.80	24.87	3.06	0.83	16.59-34.63	22.94	2.76	.02	-			
3. Perceived health status	3.84	0.75	4.12	0.70	0.39	4.06	0.69	3.66	0.82	-0.56	1-5	4.01	0.70	-.05	-.18**	-		
4. Frequency of exercise	3.47	1.53	4.13	1.69	0.41	3.74	1.65	3.95	1.60	0.13	1-7	3.88	1.58	-.13	.01	.17**	-	
5. Depressive symptomatology	1.11	0.96	0.75	0.81	-0.40	0.79	0.80	1.45	1.07	0.76	0-4	0.77	0.81	.04	.03	-.18**	-.04	-
6. Exercise in the presence of physical harm or injury	1.62	1.05	2.16	1.23	0.47	1.83	1.14	2.04	1.26	0.18	1-5	2.62	0.79	-.14*	-.02	.10	.23***	.14*

Note. BMI = Body Mass Index, ED = Eating Disorder, *d* = Effect size of differences.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 2
Linear regression analysis predicting exercise performance in the presence of physical harm or injury and depressive symptomatology.

	Model 1: R^2 = .183 DV: Exercise in the presence of physical harm or injury					Model 2: R^2 = .188 DV: Depressive symptomatology				
	β	CI 95%		*SE*	*p*	β	CI 95%		*SE*	*p*
		LB	UB				LB	UB		
Age	-.147	-.295	.001	.076	.052	.068	-.034	.169	.052	.191
Gender	.267	.166	.369	.052	< .001	-.200	-.284	-.117	.043	< .001
BMI	-.084	-.232	.064	.076	.268	-.057	-.164	.050	.055	.299
Perceived health status	.050	-.058	.159	.055	.363	-.115	-.208	-.021	.048	.016
Frequency of exercise	.198	.127	.268	.036	< .001	-.058	-.167	.051	.056	.295
ED Risk	.068	-.088	.233	.079	.394	.281	.192	.371	.046	< .001
Depressive symptomatology	.193	.098	.288	.049	< .001	-	-	-	-	-
Exercise in the presence of physical harm or injury	-	-	-	-	-	.186	.111	.261	.038	< .001

Note. DV = Dependent variable, β = Standardised regression coefficient, CI 95 % = Confidence interval at 95 %, SE = Standard error, LB = Lower bound, UB = Upper bound, BMI = body mass index, ED = Eating disorder. Being female (in the context of gender) and having been classified as "not at risk" (in the context of ED risk level) were considered as the reference categories for the dichotomous variables.

The following fit indices were obtained for the measurement model: χ^2 = 58.238, gl = 19, χ^2/gl = 3.065, p < .001; CFI = .994; RMSEA = .077 [90% CI = 055 to .100], p = .023; WRMR = 0.773. The results of the two regression models specified are presented in Table 2. The results of the first of these models showed that being male (β = .267; 95% CI = .166 to .369; p < .001), frequency of exercise β = .198; 95% CI = .127 to .268; p < .001) and the presence of depressive symptomatology (β = .193; 95% CI = .098 to .288; p < .001) positively accounted for a significant proportion of variance of exercise performance in the presence of physical harm or injury (18.30%). Results from the second of the models tested indicated that being male (β = -.200; 95% CI = -.284 to -.117; p < .001) and perceived health status (β = -.115; 95% 95% CI = -.208 to -.021; p = .016) negatively accounted for a significant proportion of variance in depressive symptomatology, whereas being at risk for an ED (β = .281; 95% CI = .192 to .371; p < .001) and exercising in the presence of physical harm or injury (β = .186; 95% CI = .111 to .261; p < .001) positively accounted for a significant proportion of variance in this dependent variable. Specifically, the variance accounted for in this second model was 18.80%.

Discussion

The aim of this study was to analyse the relationship between depressive symptomatology and problematic patterns of physical exercise. The evidence provided indicates that the results previously reported considering such patterns as behavioural addiction (Alcaraz-Ibáñez et al., 2022a) are largely replicable if they are considered in terms of persistence in exercise practice in the presence of physical harm or injury. Specifically, the findings presented suggest that, irrespective of gender, age, BMI, or risk status in terms of risk of ED, depressive symptomatology is positively associated with exercise in situations where physical harm or injury is present.

The main difference between the results reported in the reference study (Alcaraz-Ibáñez et al., 2022a) and those presented here is that the effect sizes of the relationships of interest are slightly lower in the present study. This difference could be explained by the different natures of the manifestation of the potentially problematic exercise pattern considered in the two studies. In this respect, it should be noted that one of the inherent components of behavioural addictions is the use of the particular activity (in this case, exercise) for the purpose of mood modification and thus

as a form of coping (Griffiths, 2005). It would therefore be reasonable to some extent that the existence of the negative moods inherent in depressive processes (Derogatis, 2000) could lead to a pattern of behaviour characterised to a greater extent by using the activity in question in order to improve that mood than by persisting in the practice in the absence of harm or injury.

An analogous explanation to the above could be provided by considering depressive symptoms as a possible consequence of the problematic form of exercise examined in the present study. In this sense, one of the specific components of exercise addiction concerns the presence of conflicts arising from exercise habits (Terry et al., 2004). In addition, there is evidence pointing to this component as one of the most closely related to depressive symptoms (Sicilia et al., 2020). This suggests that the negative consequences of adopting problematic exercise patterns may be more detrimental in terms of inducing greater depressive symptoms when these patterns involve some of the components not examined in this paper. In light of this reasoning, future studies should consider examining the relationship between depressive symptomatology and problematic exercise patterns by considering not one but preferably several components in isolation. Considering the large number of such components (Sicilia et al., 2022) and, in some cases, the high degree of correlation between them (Parastatidou et al., 2014), a convenient alternative for examining the relationship of interest would be to use person-centred approaches (Bergman & Andersson, 2010). Specifically, because this type of approach would allow comparison of the levels of depressive symptomatology between groups of individuals with similar profiles according to the levels shown in the different components involved in problematic exercise patterns (Sicilia et al., 2020).

A clear implication related to the professional practice of physical education teachers can be derived from the findings. In particular, the results presented here suggest the need for teachers to be aware of a twofold possibility. First, that the adoption of exercise as a form of coping in the presence of depressive states (Baker et al., 2021) could lead people suffering from such states to exercise under circumstances in which it is not advisable (i.e., in the presence of some kind of physical harm or being injured). Secondly, that persisting with exercise in the presence of harm or injury may contribute to increased levels of depressive symptomatology. It therefore seems appropriate to advise professionals in the field of physical exercise to remain attentive to the possible presence of depressive symptoms and to persistence in the practice of physical exercise in the presence of physical harm or injury in the people under their care. A possible course of action in the latter case is to warn of the potential dangers of such behaviour (e.g., aggravation/chronification of the injury or worsening of mood).

One of the main limitations of the present study is the characteristics of the instrument used in the evaluation of physical exercise in the presence of physical harm or injury. (Lichtenstein & Jensen, 2016). In this sense, it is possible that the fact that the item used refers to two different situations (i.e., the existence of physical problems and the presence of injury) could have compromised its proper understanding (Hayes & Coutts, 2020; Kyriazos & Stalikas, 2018). It is also possible that the use of a single item would have led to an undesired increase in measurement error, which could have affected the level of precision of the results (Fuchs & Diamantopoulos, 2009). In view of this limitation, future studies should corroborate the findings presented here by using validated instruments that allow for a more comprehensive assessment of the behaviour of interest. A second limitation of the present study stems from the cross-sectional and self-reported nature of the data analysed. In light of this limitation, future studies could examine the relationship between the variables of interest over time using complementary assessments to those conducted here. Examples of the above would be clinical interviews (in the case of depressive symptomatology or risk of ED), the level of prevalence of injury (García-González et al., 2015), objective data derived from the assessment of physical condition in the case of health status, or those obtained from the use of accelerometry techniques in the case of the volume of physical exercise. A third limitation stems from the specific characteristics of the participants (i.e., university students), which makes it difficult to generalise the results. It is therefore necessary that future studies address the question raised here by considering other particularly relevant populations in this context such as, for example, individuals clinically diagnosed with some type of ED (Alcaraz-Ibáñez et al., 2020) or initially sedentary individuals who are encouraged to practice exercise in order to mitigate the presence of depressive symptomatology (Béland et al., 2020).

In conclusion, the results presented suggest that depressive symptomatology and exercise in the presence of physical harm or injury may be moderately and positively related. These findings suggest the need to further study the variables that could condition this relationship, as well as to examine the possible causal nature of this relationship.

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